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A novel suture technique in the percutaneous repair of Achilles tendon rupture (TANSEL TECHNIQUE)

Repair of achilles tendon

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Abstract

Aim: The aim of this study was to present the clinical results of patients treated with a sliding, wrapping suture technique (Tansel technique) which provides rapid recovery with fewer wound site problems compared to open surgery techniques. Material and Method: A total of 34 patients were included in the study. Following the initial diagnosis made on physical examination, routine dynamic ultrasonography (USG) was applied for the determination of the rupture gap and tendon length. All the patients were evaluated in respect of the time from trauma to surgery, etiological causes, affected side, postoperative AOFAS (The American Orthopaedic Foot & Ankle Score) and Tegner scores, cruris diameter, mean time to full weight-bearing, time of return to work, time to regain pre-trauma activity level and complications. Results: The mean follow-up period was 27.7±16.8 months. According to clinical evaluations of the patients at the final follow-up examination, postoperative dorsiflexion angle and plantar flexion angle were determined as 16.3°±4.3°, 39.7°±7.1° respectively. While postoperative Tegner score was determined as 87.6±9, AOFAS score was found as 91.3±4.7. Postoperatively at sixth months, in the measurements of the cruris area diameter, 1.5±0.4 cm atrophy was detected. Of the defined major complications, tendon elongation was seen on USG in 1 (2.9%) patient. No re-rupture occurred in any patient. Discussion: Treatment of acute Achilles tendon ruptures with Tansel technique provides successful results such as resolving the problems of re-rupture and tendon elongation particularly in the postoperative tendon malacia stage. So, this technique was considered as an effective technique which could be used to resolve the disadvantages of minimally invasive percutaneous repair.

Keywords

Achilles; Tendon; Rupture; Percutaneous; Repair

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Introduction

Achilles tendon rupture is one of the most frequently encountered tendon ruptures in the orthopedic emergencies and incidence is 20-fold higher among males than females [1, 2]. In the studies over the last three decades, a linear increase in the incidence of Achilles tendon rupture had been observed. This increase was particularly in the 3rd and 4th decades of the life of young adult males [1-3]. So minimally invasive techniques are needed for the treatment of Achilles tendon rupture in the young population.

Different approaches have been reported for postoperative rehabilitation in parallel with surgery and there have been recent studies showing better results in early and more aggressive rehabilitation protocols compared to traditional rehabilitation methods [4]. As a result, it has become a requirement that current treatment protocols are problem-free and provide early recovery.

The aim of this study was to present the clinical results of patients treated with a Tansel technique which provides rapid recovery with fewer wound site problems compared to open surgery techniques and it reduces complication rates, re-rupture, and inadequate clinical results compared to many percutaneous repair techniques in the treatment of acute Achilles tendon rupture.

Material and Methods

A retrospective examination was made of a total of 52 patients who were admitted to our clinic and were diagnosed with acute Achilles tendon rupture between 2010 and 2015. Criteria for inclusion in the study were acute Achilles tendon rupture with a gap of 2-4 cm. Patients were excluded from the study if there was concomitant connective tissue disease, spontaneous rupture, a history of previous surgery around the ankle and age over 60 years. A total of 34 patients were included in the study. Following the initial diagnosis according to the physical examination, routine dynamic ultrasonography (USG) was applied for diagnosis and determination of the rupture gap and tendon length. In the first evaluation, in the gap measurements made dynamically in all the plantar and dorsal flexion ranges if any gap was determined as >4cm at any point of the range of movement, the patient was excluded from the study.

All the patients were evaluated in respect of the time from trauma to surgery, etiological causes, affected side, postoperative AOFAS (The American Orthopaedic Foot & Ankle Score) and Tegner scores, cruris diameter, mean time to full weight-bearing, time of return to work, time to regain pre-trauma activity level and complications. Data were obtained from hospital medical records and the patient's own statements.

Ethical Approval

Approval was obtained from Karabuk University Clinical Research Ethical Committee. The principles of the Helsinki Declaration and good clinical practice guidelines were followed. All patients were provided with informed consent.

Surgical Technique

All of the patients were placed in a prone position under spinal anesthesia, intravenous 1 gr ceftriaxone prophylaxis was administered perioperatively.

Exposure

Preoperatively, the gap, the suture entry points in the proximal and distal areas of the rupture and the estimated course of the sural nerve were marked on the patient with a sterile marker pen. Then making cutaneous and subcutaneous incisions, 4mm in length, in the defined suture entry points, the Achilles tendon was reached. At the lateral of the proximal side, by extending the most proximal suture point approximately 20 mm very slightly medially (approaching the tendon) from the other incisions, the sural nerve was by defining the course towards the distal, the proximity to the distal incision sites was evaluated (Figure 1).

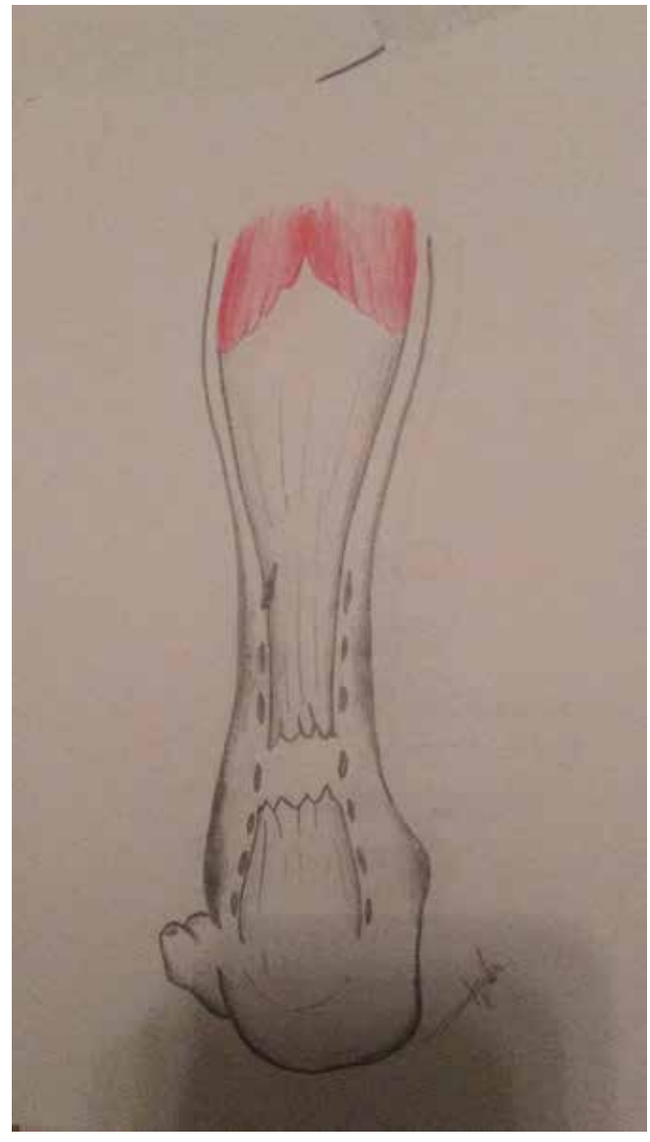

Figure 1. The proximity to the distal incision sites

Double Wrapped Suture Technique

A 2/0 PDS oval needle was straightened and entered between the skin and the gap and withdrawn from the skin opening closest to the proximal tendon on the same side. It was entered again from the same opening and passing transverse within the tendon and was withdrawn from the opposite skin opening. Entering again from the exit opening passing within the tendon, it

was withdrawn obliquely from the opening above on the opposite side. In the same way, the needle was again entered from the exit opening and withdrawn transversely along the tendon from the opposite opening. By entering again from the exit point, it was withdrawn from the opposite next opening obliquely along the tendon. Taking care of the sural nerve, entering again in the same opening thread was withdrawn from the opposite skin opening along the tendon on the opposite side and in the same way, entries were made from the most proximal skin opening and by withdrawing from the skin incision area opened in the opposite gap, the free end of the thread was finished (Figure 2). While passing through the skin, the sutures were tightened and thus loops were created between each skin incision. Another free suture was taken from these created loops from one side of the last 2 skin openings closest from the gap, so as to be fully wrapped in a circular manner 3 times around the loops and by passing within the tendon at the same level, was withdrawn from the opposite skin opening and again wrapped around the loop there (Figure 3). The same procedure was applied to the next opening. Then by pulling the looseness of the loops in the skin incision furthest from the gap, from the loop in the opposite middle skin opening, the suture was tightened and the loop disappeared (Figure 4).

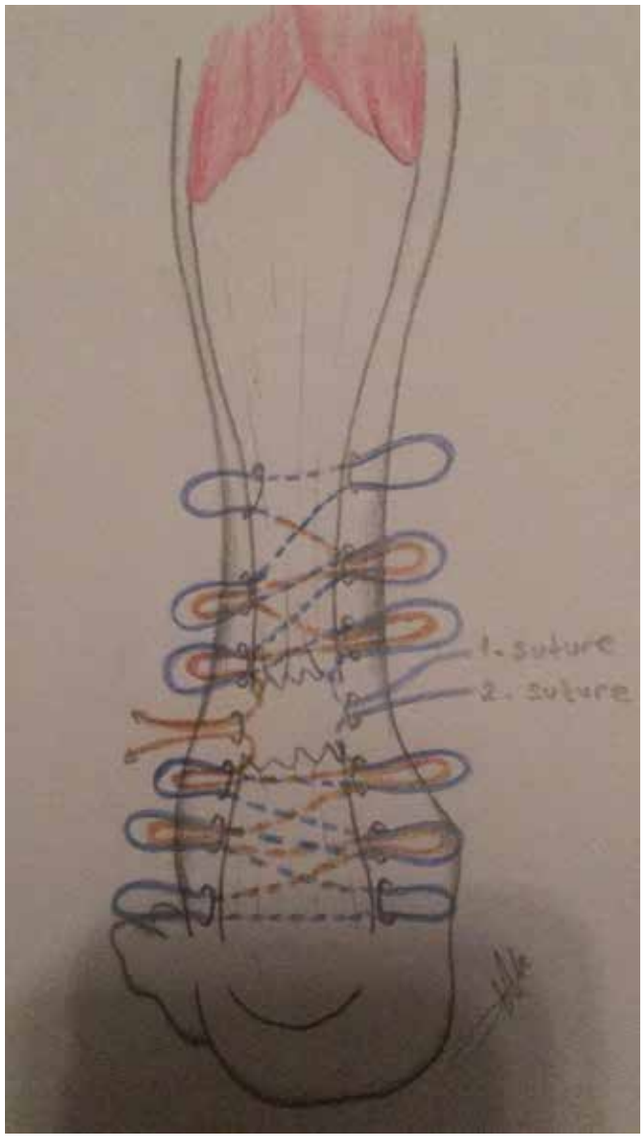

Figure 2. The free end of the thread was finished

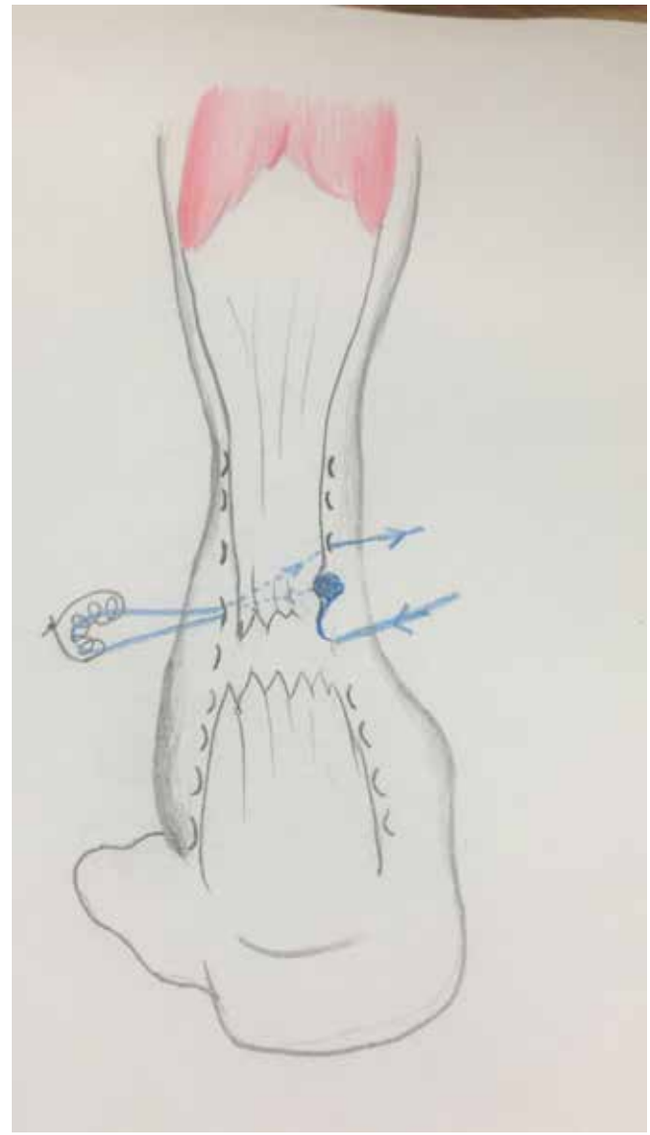

Figure 3. The loop there

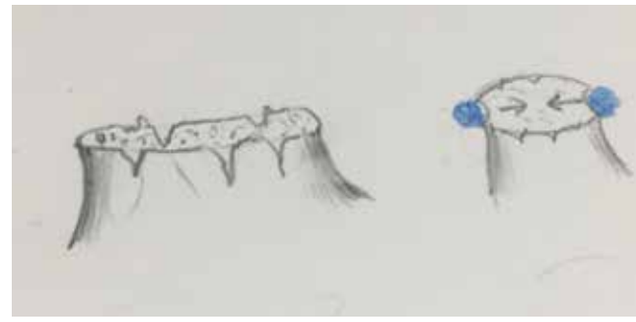

Figure 4. The loop disappeared

In the same way, by pulling the sutures from the closest skin incision to the gap, the mid-level suture loops disappeared. Finally, the suture ends in the gap were pulled. The threads were held tight and knotted by tightening the sutures which were wrapped around the loop. The same procedure was made to the part of the Achilles tendon in the distal gap. The gap sutures

were sutured on both sides at the same time by bringing the tendon ends close to each other while the foot was in maximum plantar flexion. When tying the sutures, the tendon was loose and at its shortest length, bringing the ends together by elongating the muscles without creating a gap in the rupture area, and without retracting the tendon, 6 knots were applied to provide fixation.

All the patients used a circular brace for 3 weeks postoperatively. After 3 weeks, a pneumatic adjustable angle walking brace was applied, and with the aid of this brace, partial weight-bearing was permitted for approximately 4 weeks and after the 6th week, full weight-bearing was permitted. The adjustable angle ankle brace was used for up to 7-8 weeks.

Results

Demographic data of the patients were given in Table 1. Of the defined major complications, tendon elongation was determined in 1 (2.9%) patient on USG. No re-rupture occurred in the patients. Of the defined minor complications during follow-up until the final examination, transient sural nerve pathology was determined in 2 (5.9%) patients, wound site haematoma in 1 (2.9%), loss of range of motion of 8.4°±1.8° at the final follow-up in 3 (8.8%) patients and suture granuloma in 1 (2.9%) patient.

Postoperative evaluations of the patients were shown in Table 2.

Table 1. Analysis of the demographic data of the patients

Demographic data	N
Gender (female/male)	4(11.8%)/30(88.2%)
Side (right/left)	12(35.3%)/22(64.7%)
Age (years)	40.6±10.2
Time from trauma to surgery (days)	2±1.2
Mean follow-up period (months)	27.7±16.8
Mean time to return top re-trauma level of actvity (weeks)	27.7±16.8
Mean time to full weight-bearing (weeks)	8
Mean operating time (minutes)	25.6(22-31)
Mean hospital stay (days)	1.2

Table 2. Evaluation of clinical data of the patients

Clinical data	
Postoperative dorsiflexion angle	16.3±4.3°
Postoperative plantar flexion angle	39.7±7.1°
Postoperative final Tegner score	87.6±9
Postoperative AOFAS score	91.3±4.7
Postoperative 6th month Cruris atrophy (cm)	1.5±1.5

Discussion

In the surgical treatment of acute Achilles tendon rupture, two principal techniques are most widely used; open surgical repair and minimally invasive percutaneous repair. Neither of these techniques has been defined as the gold standard for the treatment of these ruptures. It has also been proposed that conservative treatment is among the options. However, in respect of re-rupture rates, surgical treatment results have been reported to be superior to those of conservative treatment [5,6]. Nonetheless, conservative treatment has been said to be superior to surgical treatment in respect of surgical complications such as wound infection, fistula formation, skin necrosis, suture reactions and sural nerve damage [5-7]. Some authors have reported that the postoperative re-rupture rates of conservative treatment modalities were similar to those of percutaneous repair and there was no statistically significant difference [8,9].

In a study by Hsu et al. comparing percutaneous and open surgery techniques, complications were determined at the rate of 8.5% in all the patients who received surgery and no statistically significant difference was determined between the groups in respect of complication rates [10]. In a biomechanical evaluation of percutaneous and open surgical repair techniques, similar results were reported and it was suggested that there was a tendency for a longer postoperative rehabilitation period for clinical recovery in the percutaneous techniques compared to the open surgery techniques [11]. There are studies which have reported that there is a greater rate of sural nerve damage in the open surgical repair techniques [12].

Although there are many treatment options for the treatment of acute Achilles tendon rupture, there are new techniques continuously described by various authors and satisfactory results have been reported [13-17]. However, in the current approaches, no treatment algorithm has yet been widely shown to have any superiority over other techniques. Studies in the literature have reported conflicting results.

Several industrially-produced assistive instruments for the treatment of acute Achilles tendon rupture are available on the market. Sufficiently satisfactory clinical results have been reported with these instruments [10,11]. However, as the anatomic course of the sural nerve shows different variations, it has been suggested that the nerve protective effects of these instruments are weak [18,19]. In the routine percutaneous techniques applied, as the crossing point of the sural nerve to the Achilles tendon lateral nerve shows different variations and is affected by the extremity morphology of the individual, it can be said to be at risk [20].

In Tansel technique which was presented in this study, there were two features which are advantageous in comparison to other percutaneous applications. The first of these was that because of the mini skin incisions opened for the passing of the sutures, by extending the incision section in the area where the sural nerve crosses the Achilles tendon lateral nerve, the sural nerve can be explored, thus providing visual contact and complete protection of the nerve. In the current series, no sural nerve damage was seen to occur with this technique of percutaneous repair of acute Achilles tendon rupture. In literature, sural nerve damage has been reported at 13% with percutaneous Achilles tendon repair techniques [21]. Thus, by extending one section from the multiple skin incisions opened for passing the sutures, a strong advantage was provided in respect of nerve damage. The second feature which could be presented as an advantage of the technique originated from the suture technique.

In a biomechanical evaluation of the suture techniques used in open repair techniques and percutaneous repair techniques, it was reported that the open repair technique was approximately twice as strong [22]. This has created a disturbing problem for some authors. In addition to the single suture technique used in

classic percutaneous techniques, a second suture wrapped over the main bearing suture rather than the contact surface from passing a straight suture over the same suture line provided suturation with an increased holding force. This is known to reduce both re-rupture rates and prevent loss of plantar flexion force by preventing postoperative tendon elongation.

In the surgical repair of acute Achilles tendon ruptures, in the postoperative 1st and 3rd weeks, softening associated with tendomalacia which occurs biomodally as a cause of stripping over the tendon, sometimes without breakage in the suture materials, may be a cause of the failure of the repair. Following surgical repair, the suture holding capacity of the tendon increases with intrinsic healing in the 4th week [23, 24]. Therefore, the activity and survival of the suture material in the first 3 weeks is of importance. This problem, which is encountered in early rehabilitation, originates from stripping rather than breakage of the suture from the tendon [25].

In the suture technique in this study, in two levels of the main suture fixing the tendon, a second supporting suture was used by wrapping around the suture (Figures 4 and 5). With the second suture providing support such as in the form related to the stamp effect of the screw which is placed or like the knot in the entry and exit points of the main suture to the tendon, stripping of the sutures over the tendon, particularly during the high risk time of softening and sliding and embedding within the tendon are prevented. Therefore, both clinical and cosmetic advantages can be provided by a surgical procedure with strength close to the strong stabilization obtained in open surgery, which is less invasive and has lower complication rates.

Conclusion

Treatment of acute Achilles tendon ruptures with the sural nerve protective wrapping suture technique reduced the incidence of nerve damage which was a problem in percutaneous repairs. Furthermore, this technique provided successful results in resolving the problems of re-rupture and tendon elongation by providing a, particularly in the postoperative tendonmalacia stage. This technique is considered as an effective technique which can be used to resolve the inherent disadvantages of minimally invasive percutaneous repair.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

References

1. Maffulli N, Waterston SW, Squair J, Reaper J, Douglas AS. Changing incidence of Achilles tendon rupture in Scotland: a 15-year study. Clin J Sport Med 1999; 9:157-60.
2. Leppilahti J, Puranen J, Orava S. Incidence of Achilles tendon rupture. Acta Orthop Scand 1996; 67: 277-9.
3. Sode J, Obel N, Hallas J, Lassen A. Use of fluroquinolone and risk of Achilles tendon rupture: a population-based cohort study. Eur J Clin Pharmacol 2007; 63: 499-503
4. Kangas J, Pajala A, Siira P, Hämäläinen M, Leppilahti J. Early functional treatment versus early immobilization in tension of the musculotendinous unit after Achilles rupture repair: a prospective, randomized, clinical study. J Trauma 2003; 54: 1171-80
5. Pajala A, Kangas J, Siira P, Ohtonen P, Leppilahti J. Augmented compared with nonaugmented surgical repair of a fresh total Achilles tendon rupture. A prospective randomized study. J Bone Joint Surg Am 2009; 91: 1092-100
6. Khan RJ, Fick D, Keogh A, Crawford J, Brammar T, Parker M. Treatment of acute Achilles tendon ruptures. A meta-analysis of randomized, controlled trials. J Bone Joint Surg Am 2005; 87: 2202-10.
7. Mortensen HM, Skov O, Jensen PE. Early motion of the ankle after operative treatment of a rupture of the Achilles tendon. A prospective, randomized clinical and radiographic study. J Bone Joint Surg Am 1999; 81: 983-90.
8. Marx RC, Mizel MS. What's new in foot and ankle surgery. J Bone Joint Surg Am 2010; 92: 512-23
9. Saleh M, Marshall PD, Senior R, MacFarlane A. The Sheffield splint for controlled early mobilisation after rupture of calcaneal tendon. A prospective, randomised comparison with plaster treatment. J Bone Joint Surg Br 1992; 74: 206-9.
10. Hsu AR, Jones CP, Cohen BE, Davis WH, Ellington JK, Anderson RB. Clinical Outcomes and Complications of Percutaneous Achilles Repair System Versus Open Technique for Acute Achilles Tendon Ruptures. Foot Ankle Int. 2015; 36(11):1279-86.
11. Clanton TO, Haytmanek CT, Williams BT, Civitarese DM, Turnbull TL, Massey MB, A Biomechanical Comparison of Open Repair and 3 Minimally Invasive percutaneous Achilles Tendon Repair Techniques During a Simulated, Progressive Rehabilitation Protocol. Am J Sports Med. 2015;43(8):1957-64.
12. Aibinder WR, Patel A, Arnouk J, El-Gendi H, Korshunov Y, Mitgang J, Uribe J. The rate of sural nerve violation using the Achillon device: a cadaveric study. Foot Ankle Int 2013; 34: 870-875
13. Hegewald KW, Doyle MD, Todd NW, Rush SM. Minimally Invasive Approach to Achilles Tendon Pathology. J Foot Ankle Surg. 2016; 55(1):166-8.
14. Corradino B, Di Lorenzo S, Calamia C, Moschella F. Surgical repair of acute Achilles tendon rupture with an end-to-end tendon suture and tendon flap. Injury. 2015; 46(8): 1637-40.
15. Kocaoglu B, Ulku TK, Gereli A, Karahan M, Turkmen M. Evaluation of absorbable and nonabsorbable sutures for repair of achilles tendon rupture with a suture-guiding device. Foot Ankle Int. 2015; 36(6): 691-5.
16. Giannetti S, Patricola AA, Stancati A, Santucci A. Intraoperative ultrasound assistance for percutaneous repair of the acute Achilles tendon rupture. Orthopedics. 2014; 37(12): 820-4.
17. Bevoni R, Angelini A, D'Apote G, Berti L, Fusaro I, Ellis S, Schuh R, Long term results of acute achilles repair with triple-bundle technique and early rehabilitation protocol. Injury. 2015 ; 46(8): 1637-40.
18. Porter KJ, Amin A. Re: An anatomical and cadaveric study examining the risk of sural nerve injury in percutaneous achilles tendon repair using the achillon device. Foot Ankle Surg. 2015 ;21(2): 147.
19. Aibinder WR, Patel A, Arnouk J, El-Gendi H, Korshunov Y, Mitgang J, et al. The rate of sural nerve violation using the Achillon device: a cadaveric study. Foot Ankle Int. 2013; 34(6): 870-5.
20. Blackmon JA, Atsas S, Clarkson MJ, Fox JN, Daney BT, Dodson SC, et al. Locating the sural nerve during calcaneal (Achilles) tendon repair with confidence: a cadaveric study with clinical applications. J Foot Ankle Surg. 2013; 52(1): 42-7.
21. Klein W, Lang DM, Saleh M. The use of the Ma-Griffith technique for percutaneous repair of fresh ruptured tendo achillis. Chir Organi Mov. 1991; 76(3): 223-8.
22. Hockenbury RT, Johns JC. A biomechanical in vitro comparison of open versus percutaneous repair of tendon achilles. Foot Ankle. 1990 ; 11(2): 67-72.
23. Nystrom B, Holmlund D. Separation of tendon ends after suture of achilles tendon. Scand J Plast Reconstr Surg. 1983;17(1): 19-23.
24. Yildirim Y, Kara H, Cabukoglu C, Esemenli T. Suture holding capacity of theAchilles tendon during the healing period: an in vivo experimental study in rabbits. Foot Ankle Int. 2006; 27(2): 121-4.
25. Yildirim Y, Esemenli T. Initial pull-out strength of tendon sutures: an in vitro study in sheep achilles tendon. Foot Ankle Int. 2002; 23(12): 1126-30.

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